CLAIMS

1. A method of characterising a three phase transformer having three input terminals and three output terminals using a single phase power supply, the method comprising the steps of:
   sequentially connecting the single phase power supply between all three available pairs of input terminals selected from the three input terminals of the transformer so as to energise each available pair of input terminals in turn;
   during energisation of each pair of terminals measuring the voltage between all three available pairs of output terminals selected from the three output terminals of the transformer; and
   processing the measured voltages to characterise the transformer.

2. A method as claimed in claim 1 wherein the measured voltages are processed to characterise the transformer according to its winding configuration.

3. A method as claimed in claim 2 wherein the transformer is classified as D-D equivalent, D-Y equivalent, Y-D equivalent or Y-Y equivalent.

4. A method as claimed in any preceding claim wherein the three voltages measured during energisation of each pair of input terminals are processed to identify the highest, lowest and intermediate value and the difference between the intermediate value less the lowest value computed and then divided by the highest value to produce three figures of merit, one associated with energisation of each pair of input terminals.

5. A method as claimed in claim 4 wherein each figure of merit is classified into one of four classes according to its value.

6. A method as claimed in claim 5 wherein each figure of merit is classified in a first

class if it is greater than 0.82, a second class if it is less than or equal to 0.82 but greater than 0.45, a third class if it is less than or equal to 0.45 but greater than 0.16 and a fourth class if it is less than or equal to 0.16.

7. A method as claimed in either claim 5 or 6 wherein a value is allocated to each figure of merit according to its classification, the allocated values are then added, and the transformer classified as D-D equivalent, D-Y equivalent, Y-D equivalent or Y-Y equivalent according to the total.

8. A method as claimed in claim 7 wherein the first, second, third and fourth classes are allocated the decimal numbers 64, 16, 4 and 1 respectively, (or equivalent numbers in a different base) and the transformer classified as follows according to the total of the allocated values:

Winding classification	Sum of values
D-D	33
D-Y	72
Y-D	96
Y-Y	9

9. A method as claimed in any preceding claim wherein the transformer is characterised according to the presence of neutrals on its primary and/or secondary side.

10. A method as claimed in claim 9 wherein the transformer has three input terminals H1, H2 and H3 and an input neutral terminal H0 and three output terminals X1, X2 and X3 and an output neutral X0 and when the single phase power supply is connected between input terminals H1 and H3 the highest voltage measured between output terminals X1 and X3, X2 and X1 and X3 and X2 is saved (X_{pp}) and the highest voltage measured between X1 and X0, X2 and X0 and X3 and X0 is saved (X_{pn}) and further comprising the step of connecting the single phase

power supply between H1 and H0, measuring the voltages between X1 and X3, X2 and X1, and X3 and X2, saving the highest value (X_{np}) and determining the ratios of the first saved voltage with each of the second and third saved voltages respectively (X_{pn}/X_{pp} and X_{np}/X_{pp}) thereby to determine the presence of neutrals on the primary and/or secondary side of the transformer.

11. A method as claimed in claim 10 when dependent directly or indirectly on claim 3 wherein the presence or absence of a neutrals is combined with the classification of winding configuration in order to further classify the winding configuration of the transformer as one of the following:

a) D-D or D-Z or Z-D or Z-Z
b) D-Z_n
c) Z_n-D or Z_n-Z
d) Z_n-Z_n
e) D-Y or Z-Y
f) D-Y_n or Z-Y_n
g) Z_n-Y
h) Z_n-Y_n
i) Y-D or Y-Z
j) Y-Z_n
k) Y_n-D or Y_n-Z
l) Y_n-Z_n
m) Y-Y
n) Y-Y_n
o) Y_n-Y
p) Y_n-Y_n

12. A method as claimed in claim 3 or any of claims 4 to 11 when dependent, directly or indirectly upon claim 3, wherein the phase displacement of the transformer is calculated by the following steps:

determining if the primary and secondary winding configurations are similar and if not allocating a value of 1, otherwise allocating a value of 0;
determining a configuration result factor and adding a value according to the configuration result factor to the value allocated in the previous step;
determining if the secondary winding of the transformer windings is reversed and if not adding 6 to the value calculated in the previous step, otherwise leaving the value unaltered; and
if the value is greater than 12 substracting 12, otherwise leaving the value unaltered, thereby to determine the phase displacement of the transformer.

13. A method as claimed in claim 12 wherein the configuration result factor is determined as follows:
during energisation of each pair of input terminals shorting the remaining terminal to the low end of the energising power supply noting the pair of output terminals across which the lowest output is measured and allocating a value depending on at which pair of output terminals the lowest output is measured, said value also depending upon whether or not the primary and secondary winding configurations are similar or not and naming the three values allocated to obtain the configuration result factor.

14. A method according to either claim 12 or 13 wherein to determine if the secondary windings of the transformer are reversed the transformer is energised phase to phase on the primary and a corresponding phase to phase measurement made on the secondary and measuring the phase shift and the primary with respect to the secondary.

15. Apparatus for characterising a three phase transformer using a method as claimed in any preceding claim.

16. Apparatus as claimed in claim 15 comprising:
a single phase power supply; means for selectively applying power from said

power supply to pairs of input terminals of a three phase transformer; means for measuring the voltage between pairs of output terminals of a three phase transformer and a control means comprising a processing means, said control means being operative to control said power supply, means for measuring voltages and processing means thereby to characterise a transformer.

17. Apparatus as claimed in claim 16 further comprising a phase meter under control of the control means.

18. Apparatus as claimed in either claim 16 or 17 wherein the control means comprises a programmed computer.